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Videofluorography and the assessment of velopharyngeal competence.

Kathleen Ruth Tate
The University of Montana

VIDEOFLUOROGRAPHY AND THE ASSESSMENT

OF VELOPHARYNGEAL COMPETENCE

By

Kathleen R. Tate

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Approved By:

Charles D. Parker

Chairman, Board of Examiners

John M. Stewart

Dean, Graduate School

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Introduction

The speech pathologist needs to understand the useful information derived from videofluorography in assessing velopharyngeal competency. The objective diagnostic data provided by the videofluorographic procedures can have critical impact on the recommendations for surgical or therapeutic intervention. As Skolnick, McCall and Barnes (1973) point out, it is necessary to know the precise defect in a patient's velopharyngeal (VP) closure mechanism prior to initiating procedures to correct the abnormalities producing the deviant speech. This paper will attempt to explain the videofluorographic techniques currently available and the importance of the information to be gained through their application.

In assessing VP competency, the speech pathologist typically conducts an oral peripheral examination and obtains a speech sample to evaluate the articulatory and resonance characteristics of the patient's speech. From the speech sample, indications of the presence or absence of VP incompetence and the consistency of the incompetency are obtained. However these speech symptoms provide no information as to the precise defects in the mechanism that are producing the imcompetece. Diagnostic information gleaned from the oral peripheral examination is minimal and often in error. Judgement of palatal length relative to the depth of the nasopharynx is frequently incorrect because the epipharynx, which varies considerably in height, depth and configuration, is above the level of view through the mouth. Likewise, the critical mesial movement of the pharyngeal muscalature involved in VP closure also occurs at a level above that which can be seen through the mouth. Direct visualization by way of an oral peripheral examination does not allow for assessment of the degree of relative contribution to the velar and pharyngeal components to the total sphincteric mechanism of the VP closure (Skolnick et al, 1973).

If the speech pathologist has access to cine- or videofluorographic equipment, only limited information is provided by the traditional lateral view. This lateral view procedure is limited because it represents only two dimensions of a three dimensional process -- the sphincteric mechanism of VP closure. However, accurate assessment of the VP function can be obtained by videofluorographic techniques that simultaneously record sound and movement of speech in sequential, multiple projections.

A brief discussion of the sphincteric action of the closure mechanism is presented first to orient the reader to the structures and functions of the VP mechanism. The next section of this paper explains the videofluorographic techniques utilized to obtain the necessary information to judge VP competency. Greater detail of the information provided in the four views of videofluorographic procedures is then discussed; illustrations depicting the structures and their roles in VP closure are presented for each view. Another section examines the application of videofluorographic data to the diagnosis and recommendations made by the speech pathologist and surgeon. Some information covered in this paper may extend into the fields of plastic surgery and radiology, but knowledge of this information is important if a speech pathologist is to function effectively as a member of an interdisciplinary team, such as a cleft palate team. The last section of this paper consists of videofluorographic procedures, the interpretation of the information they provide, and the application of this information in making accurate diagnosis and recommendations.

The Mechanics of Closure

To describe the sphincteric action of VP closure in normal subjects, Skolnick, et al (1973) divides it into two major components -- velar and pharyngeal. The velar component refers to the movements of velar elevation and posterior elongation, with the velum forming the anterior margin of the sphincteric mechanism. The pharyngeal component forms the balance of the VP sphincter, including all movements of the naso-pharyngeal wall. Skolnick, Shprintzen, McCall and Rakoff (1975) expand on these functions in the following description of VP closure in speech or normal adult subjects: 1) postero-superior movement of the velum, 2) velum approximates the posterior aspect of the pharyngeal walls, 3) this approximation occurs at a point below the levator eminence and medial movement of the lateral aspect of the pharyngeal walls, 4) mesial movement of the lateral pharyngeal walls approximates the lateral edges of the velum. The mesial movements of the lateral pharyngeal walls primarily occur at a specific level and resemble a shelf in the lateral walls on the plane of the hard palate.

Shprintzen, McCall, Skolnick, and Lencione (1975) and Astley (1958) agree that the maximal medial excursion in the lateral walls of the pharynx occurs at the level of the hard palate, well below the levator eminence. It is hypothesized that this maximal excursion point may be due to the contraction of those fibers of the superior constrictor muscle which enter the velum via the lateral walls and of those fibers attached to the pterygoid plates as well as to levator muscle activity.

The musculature involved in the mid-sagittal VP contact, the velar component, emanates from the combined contractions of the levator palatini and the palatopharyngeus muscles. Skolnick (1969) states that the movements of the lateral walls result from contraction of fibers of the superior constructor that insert bilaterally into the velar aponeurosis and the palatopharyngeus muscle; it is possible that the salpingopharyngeus muscle is also involved in the process.

Skolnick, et al (1973) found the final closure pattern in normal subjects to be a coronally oriented slit. In patients with adequate VP closure for speech, but exhibiting either a foreshortened velum, decreased velar elevation, or Passavant's pad, the closure pattern tended to be circular. This type of closure was associated with increased movement of the pharyngeal component of the VP sphincter. Closure depicting a sagitally oriented slit also appeared to be related to increased movement of the pharyngeal component.

In patients with incompetent closure mecahnisms, the number of patterns at closure attempts was greater than that seen in patients with VP competence (Skolnick, et al, 1973). Among the sphincteric patterns during attempted closure in the incompetent group were those seen in people with VP competence; however, additional patterns occurred as well in the incompetent group.

Skolnick, et al (1975) examined the VP closure mechanism of thirty youngsters with repaired cleft palates who had normal speech and found the mechanics of VP closure to be essentially the same as with normal adults; they noted that although anatomical differences existed, the mechanics of closure remained the same. The greatest anatomical difference seen in the thirty youngsters with repaired palates was the presence of a prominent adenoid mass in the masopharynx. All thirty subjects used this mass as a point of closure. That is, closure was achieved between the superior surface of the velum and the inferior surface of the adenoid mass. The discrete levator eminence was often not present due to the small space between the velum at rest and the adenoid. In eight of the thirty subjects, the lateral walls were observed to abut in the mid-line just below the adenoid mass. Hence, the lateral pharyngeal walls appeared to abut posterior to the velum because the adenoid mass prevented the velum from inserting itself between the moving lateral walls.

Skolnick, _et al_ (1975) discussed the role of adenoids in VP closure in children and their nonparticipation in VP closure in adults. In adults, midfacial growth results in an increase of the vertical dimension of the nasopharynx; if the adenoids have not atrophied and are still present in an adult, they now sit above the hard palate and above the level of closure. In children, the vertical height of the nasopharynx is compressed, thus bringing the adenoids into the level of VP closure. As a child grows, the adenoids atrophy and the vertical dimension of the nasopharynx increases, thus removing them from the level of VP closure. The child's previous pattern of velar-adenoidal closure is replaced by velar-pharyngeal closure.

Videofluorographic Procedures

This paper discusses videofluorography rather than cirefluorography because of the several advantages it offers. A video recorder that also has sound is generally less expensive than a 16 mm recording camera. With videofluorography, immediate feedback is available for checking technical and diagnostic quality before the patient leaves. Regarding patient radiation exposure, Skolnick (1969, 1970) found that the skin roentgen dosage using the video system was considerably less; depending on the equipment, the radiation dosage for videofluorography may be only 60 per cent of that necessary for 16 mm cinefluorography.

Greater detail will be given in the next section regarding useful information derived from the various videofluorography views. For orientation purposes, a brief description of each view is now offered. The lateral view provides information regarding mid-sagittal elevation, posterior movement of the velum and anterior movement of the pharyngeal wall. The frontal view, or A-P (anterior-posterior), demonstrates the degree of lateral wall movement toward the midline and the cranial-caudal length of the approximation site. The basal view, or en face, shows the entire perimeter of the VP portal and demonstrates the sphincteric action in closure. The Towne view evolved to study better lateral wall defects; this view is perpendicular to the VP sphincter and shows the purse-string nature of it.

A coating of barium is necessary to adequately visualize the lateral and posterior walls and the superior surfaces of the velum. The barium helps to distinguish the velum and pharyngeal walls from the soft tissues and osseous structures above and below. No pre-medication for installation of the barium is required. The patient sniffs a small amount of liquid barium into each nostril through a small tube.

Skolnick (1970) discussed the pros and cons of taking lateral views with and without a barium coating. Because barium helps to define the margins of the velum and posterior wall, a clearer picture of actual VP contact or just close approximation between the two structures can be readily seen. However, the length of the velum is often obscured because the barium coating tends to mix with the mucous and gather around the uvula, thus giving the appearance of a longer velum. The barium coating may also frequently obscure the viewing of a pharyngeal flap.

Oftentimes, young children will not tolerate the nasal installation of barium; so in these cases, a lateral view is taken without the barium. A clear view of VP contact is about the only information obtained in this manner. Ideally, a set of lateral views taken first without the barium coating, and then with it would provide the maximum information to be obtained from the lateral view.

To obtain a good basal view of the VP portal, the plane of the portal must be horizontal and therefore perpendicular to the X-ray beam. Skolnick (1970) found that the plane of the portal varies from patient to patient and is different among age groups. He stated that the position of the plane depended on: 1) level of the posterior wall with which the velum makes contact or to which it comes close, 2) the contour of the posterior pharyngeal wall, 3) prominence of the adenoid mass if present. Thus, the radiologist locates the exact head position fluoroscopically. First, the patient's head is positioned so that the invisible line running from the external auditory canal through the corner of the lips is horizontal. Then the fluoroscopic carriage is placed overhead and centered on the portal. If the portal is perpendicular to the X-ray beam, it is seen during quiet breathing as a radiolucent oval fully marginated with barium. During phonation, the margins contract centrally.

Skolnick (1970) cited some of the problems in obtaining an accurate basal view of the portal. If the head is elevated too much or not enough, the plane of the portal will not be perpendicular to the X-ray beam and so the portal cannot be viewed en face. Sometimes the basal projection cannot be obtained because the patient's neck is too short to permit enough head elevation or because the plane of the portal cannot be brought to the horizontal position.

Isshiki, Honjow, and Morimoto (1969) noted that the major problem in visualizing movement of the lateral walls in the frontal view was avoiding the superimposition of the lateral wall over hard and massive structures such as the maxilla, tongue and mandible. They found that lateral wall movement was best demonstrated when projected through the mouth opening as with the phonation of /a/; inferior visualization of lateral wall movement resulted with activities such as connected speech, blowing, gagging and swallowing. Barium coating may be helpful in defining the level of the velum, but the coating frequently does not adhere to the lateral walls because of the mucous covering them.

The procedure for obtaining a Towne projection is performed with the patient supine on the fluoroscopic table with his chin tucked into the chest. Cotton and Quattromani (1977) stated that the X-ray beam is perpendicular to the table and the meato-orbital line angled at thirty degrees caudal from the X-ray beam. The final angle of the Towne view is adjusted by fluoroscopic observation and equipment alignment. Barium coating is used with this procedure.

Information from Videofluorography

To fully appreciate videofluorographic results, knowledge of the information these techniques offer is mandatory. Information provided by each view will be discussed, followed by examination of the multiple-view results and how they related to future-planned flap surgery, failure of previous flap surgery, and various speech activities.

Lateral Projection

In the lateral projection (see Figure 1) the velum can be visually inspected for length, contour, degree of mobility, degree of elevation during phonation, and forcefulness of VP contact. Skolnick (1970) noted that in normal subjects without prominent adenoids, the velum elevated to the level of the hard palate and levator eminence; the eminence was that area usually making contact with the posterior pharyngeal wall. During contact, the velar surface appeared to flatten for several millimeters. When adenoids were present, full elevation of the velum was prevented. Blowing activity and quiet breathing demonstrated the degree of velum flexibility and maximum elevation. From the lateral view, position of the tongue can be viewed. The patient compensating with a high-riding posterior tongue carriage can easily be detected. Also, anterior movement of the posterior pharyngeal wall, if present, can be seen. Kelsey (1972) noted that in observing bubbles in the barium at the level of VP contact during speech activity may be indicative of minimal VP insufficiency. With speech samples, attention must be given to the occurrance of nasal consonants relating to appropriate air escapage. Hence the need for synchronized sound with videofluorography becomes more apparent.

Frontal View

Skolnick, et al (1973) described the frontal view (see Figure 2) as best demonstrating the vertical length of the lateral aspects of the moving pharyngeal walls. When the frontal view is used in conjunction with the lateral view, the relationship of the velar eminence to the region of the maximum mesial movement of the lateral walls is demonstrated. Such information is important to the plastic surgeon planning a pharyngeal flap surgery. The flap should be attached to the level where maximum mesial movement occurs in phonation, Isshiki, et al (1969) points out that in a case that shows quite a long vertical approximation of lateral wall motion, the position of the flap would not be as critical. One disadvantage in use of the frontal view is the inability to view lateral wall movement during connected speech. As mentioned earlier, phonation of /a/ provided the best visualization of maximum mesial movement due to the steady, open-mouth posture. The dynamics of connected speech and the relation to maximum mesial excursion of the lateral walls are lost with the frontal view.

Kelsy (1972) employed an equal interval psychophysical scale for rating movement of the lateral walls as a predictive device for flap surgery results. He found that lateral pharyngeal wall ratings could be used to predict preoperatively the success of surgery in 1) reducing nasality, 2) nasal emission, and 3) increasing speech intelligibility. Such ratings provide additional information as to the success for conventional pharyngeal flap surgical procedures. As Cotton and Quattromani (1977) observe, additional diagnostic information aids the surgeon in choosing the best procedure appropriate to his patient's individual needs.

Information from the lateral and frontal views still does not provide insight into the actual sphincter function of the closure mechanism. The Towne and basal views offer indirect visualization of the sphincteric action in VP closure.

Towne View

Cotton and Quattromani (1977) point out that with the Towne view (see Figure 3) the VP area is seen as the true purse-string sphincter that it is, and that lateral wall insufficiency can be recognized more readily. Because the Towne view orientation is perpendicular to the VP sphincter, simultaneous visualization of the lateral walls, velum and posterior wall of the nasopharynx is permitted. Closure that is defective because of limited medial movement of one or both lateral walls can be clearly detected, even though adequate mid-sagittal contact may be present. The Towne view provides confirmation of results found in the basal view; both views focus on the sphincteric action of VP closure and reveal any insufficiency in lateral wall movement.

Basal View

The basal view shows the relationship of the velum, lateral walls and posterior pharyngeal wall and depicts the meachanics of sphincteric action involved in VP closure (see Figure 4). Skolnick, et al (1973) noted that the basal view revealed the lateral walls to be only the most lateral aspects of an oval sphincter that is medially contracting. In the basal view, the lateral and posterior aspects of the pharyngeal wall do not appear radiographically to be distinct and separate moving structures. Instead, the nasopharyngeal wall seems to move as a single functional unit. Skolnick, et al (1973) add that there is really not precise fluoroscopic demarcation between the lateral aspects of the velum and the beginnings of the pharyngeal wall.

The application of information provided by the multiple videofluorographic views is critical in planning the best pharyngeal flap surgical procedure. With potential flap patients, closure is dependent upon sufficient medial movement of the lateral walls to close the portals on both sides of the flap. Therefore, the position of the flap must occupy the gap between the lateral walls at the region of maximum medial movement (Skolnick and McCall, 1972). The critical factors in achieving VP competence by performing pharyngeal flap surgery include: 1) width of the flap, 2) vertical level of the flap in the nasopharynx, and 3) position of the flap in relation to the lateral walls on the horizontal plane. Skolnick and McCall (1972) described the ideal outcome of a pharyngeal flap procedure as follows: 1) the flap occupies approximately one third of the distance between the lateral pharyngeal walls on the horizontal plane, 2) the vertical level of the flap in the nasopharynx is at the region of maximum medial movement of the lateral walls, 3) the medial movement of the lateral walls is bilaterally symmetrical and sufficient to close the portals on both sides of the flap. How the surgeon's choice of flap procedures is influenced by information presented in the videofluorography will be discussed in the next section.

Skolnick (1969) briefly discussed some aspects of mid-sagittal VP contact and lateral wall movement in patients with hypernasal speech. He realized that the significance of a VP gap became meaningful when correlated with the sound during which it occurred. For instance, a gap of several millimeters that correlated to nasal consonants, or to assimilated nasality on vowels, did not result in inappropriate nasality; but the appearance of the same gap with plosive and sibilant sounds resulted in nasal emissions. Skolnick (1969) found that the degree of nasality was not always proportional to a mid-sagittal gap seen in the lateral view because the medial movement of the lateral walls may compensate for inadequate mid-sagittal contact; however, such information should be seen in the basal and Towne views. He also found that the degree of lateral wall movement usually paralleled the degree of mid-sagittal closure for various sounds; but greater lateral movement during plosive and sibilant productions, and less on vowels, was observed.

It is often useful to obtain videofluorographic examples of connected speech as well as isolated speech sound productions. Sometimes the patient can produce isolated sounds with adequate VP closure as revealed in the multiple views; but in connected speech, the rapid, co-articulatory movements reveal an inadeuate closure mechanism. Frequently in such cases, the patient requires intensive speech therapy to train correct usage of the closure mechanism in the presence of the rapid, co-articulation in ongoing speech. With some patients, intensive training proves futile because for some reason, the multiple demands on the closure mechanism in connected speech exceed the system's physiological capacity to function; so, closure assistance via surgical intervention might be recommended.

Influences of Videofluorographic Information on Recommendations

The surgeon contemplating the value of pharyngeal flap surgery for a patient would be wise to analyze the videofluorographic information carefully before selecting a surgical procedure. Adequate pre-operative evaluation of the VP sphincter mechanism is essential to determine if alternative surgical procedures are indicated (Skilnick, et al, 1973; Cotton and Quattromani, 1977; Skolnick, 1969). The standard centrally-based flap, inferior or superior, may not be best suited to the patient's defects of the closure mechanism. If the lateral wall movement were asymmetrical, perhaps it would be decided to position the flap to favor the lateral wall with the least movement. Knowing the level at which maximum medial movement of the lateral walls occurs will determine the vertical positioning of the flap. From the multiple projections in videofluorography, the surgeon can decide if a push-back procedure in conjunction with the flap is indicated. The lateral view would demonstrate any mid-sagittal gap, and the Towne and basal views would show the movement of the velum, posterior and lateral walls in the sphincteric action. Should the videofluorography reveal poor lateral wall movement, then the surgeon might consider the benefits of performing a muscle transfer procedure, using Teflon, or Hogan's latera port control method (Cotton and Quattromani, 1977). The surgeon might also choose to perform a wide-based flap procedure if only minimal lateral wall movement was demonstrated videofluorographically.

The surgeon evaluating the effectiveness of a flap procedure post-operatively should study the Towne and basal views to assess closure of the lateral portals--thus determining if the flap base is wide enough and positioned correctly on the vertical and horizontal planes. Examination of the flap in the basal and Towne views should reveal any tethering; that is, if the flap has shrunk and the contracture of scar tissue has inadvertently pulled the flap to one side, thus leaving unplanned asymmetrical lateral portals.

Much of this information concerning surgical procedures is also of use to the speech pathologist. For example, when therapy has proven unsuccessful with a post-operative flap patient, the speech pathologist should look for problem areas videofluorographically. Such information regarding the physiological capability of the mechanism for competent closure would save valuable therapy time and aid in the predictability of outcome. The speech pathologist then would not frustrate him/herself and the patient by demanding a closure performance that the mechanism is not physiologically capable of achieving.

Videofluorographic information is also useful to the speech pathologist whose patient has nasality and nasal emission inconsistently only in connected speech, but not in isolated sound productions. If this condition resulted following flap surgery, the recommendation for intensive therapy to train VP competency in connected speech might be made. If, however, such a condition persisted in spite of therapeutic intervention, the videofluorographic results may reveal an anatomical defect rendering the mechanism incapable of adequate closure in speech. Objective data to assess the physiological integrity of the sphincteric closure are critical in evaluating VP competency.

Observing tongue movement and carriage in the lateral view may lead to recommending therapy for training anterior tongue carriage if a high-riding posterior tongue serving as a compensatory device has been detected.

Occasionally following flap surgery, a latency period occurs before the patient adequately closes off the VP portal in speech. Once the mechanism of the sphincter closure has been adequately trained and onset of closure has been coordinated with the rapid, co-articulation of ongoing speech, VP competency has been achieved. In such a case, therapy to train timing and closure would be recommended.

Skolnick (1969) stated that videofluorography might prove to be useful therapeutic tool to the speech pathologist. He saw videofluorography as providing a visual method of determining the effectiveness of particular sounds in closing the portal. As mentioned earlier, he observed greater lateral wall movement during plosive and sibilant productions, with less movement during vowel productions.

Shprintzen, McCall and Skolnick (1975) utilized videofluorography to establish the presence of VP competence for whistling and blowing among subjects who could not attain normal closure for speech. Aided with this information, they operantly conditioned successive approximation to competent speech via competent blowing and whistling closure mechanisms. They claimed successful reduction of nasal emission and nasality for two of the four subjects; credit for progress with a third subject was partially attributed to the new presence of a pharyngeal flap.

The greatest advantage resulting from videofluorographic information is that the speech pathologist need no longer routinely recommend a period of trial therapy in order to assess VP competency for speech. Historically, the speech pathologist has conservatively advised trial therapy to avoid recommending prematurely a flap operation or some other surgery. There are cases in which trial therapy is warranted as was mentioned earlier; for example, training the closure mechanism to function adequately in the presence of rapid, co-articulation in connected speech would merit a period of trial therapy. Whenever subjective data, such as listening to a patient's speech, are the cornerstone of diagnostic information, the tendancy is to be conservative. With multiple-view videofluorography, objective data are available to make accurate judgements of VP competence. Videofluorographic procedures and the valuable information they provide expedite making decisions for surgical and/or therapeutic intervention.

Summary

To summarize the multiple-view videofluorographic procedure and the information they yield, a demonstration video-tape has been made. The accompanying narrative (Appendix A) will discuss the diagnostic information provided by each view and how this information leads to accurate judgements of VP competence and germane recommendations.

LATERAL VIEW

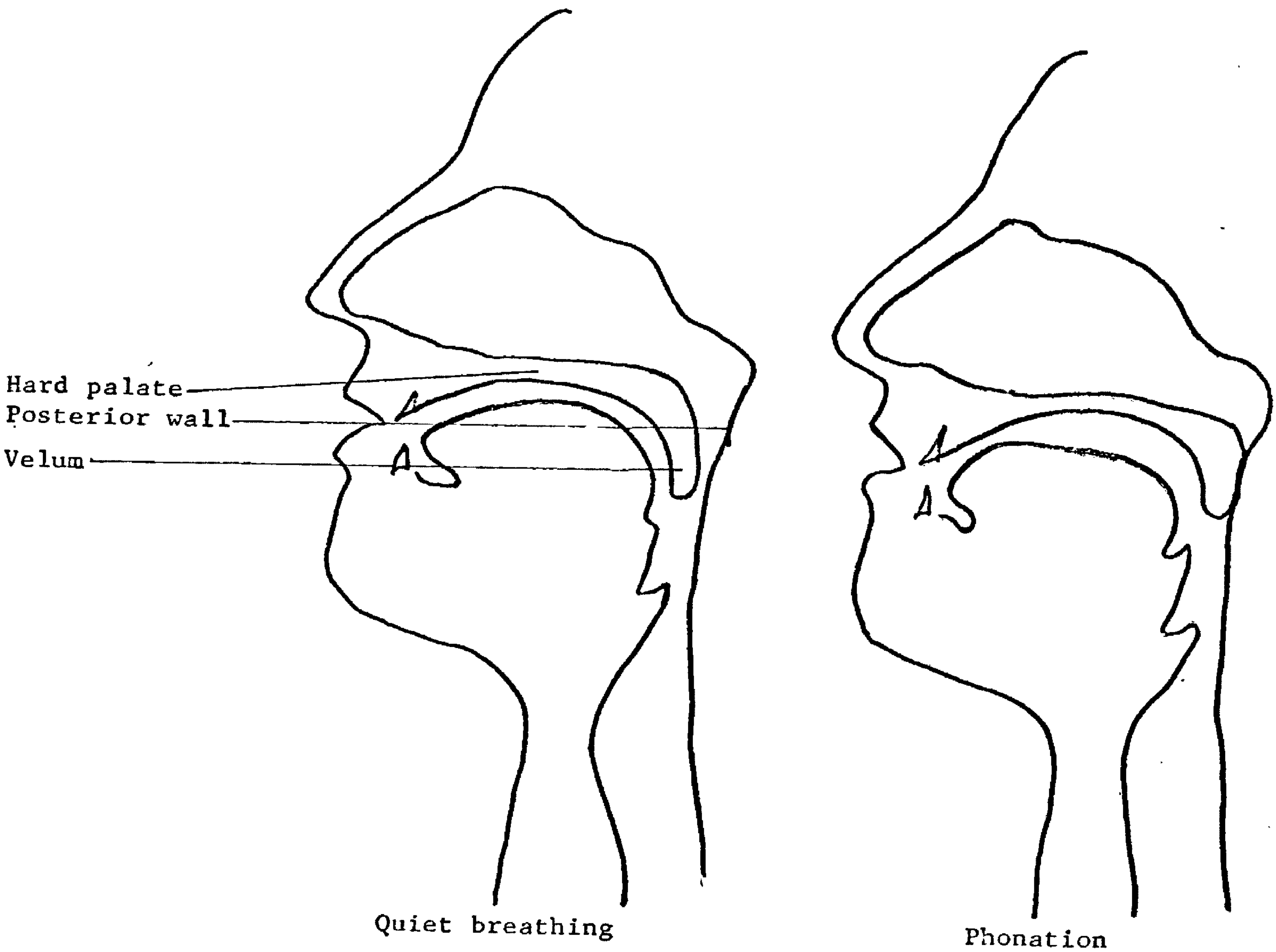


Fig. 1

FRONTAL VIEW

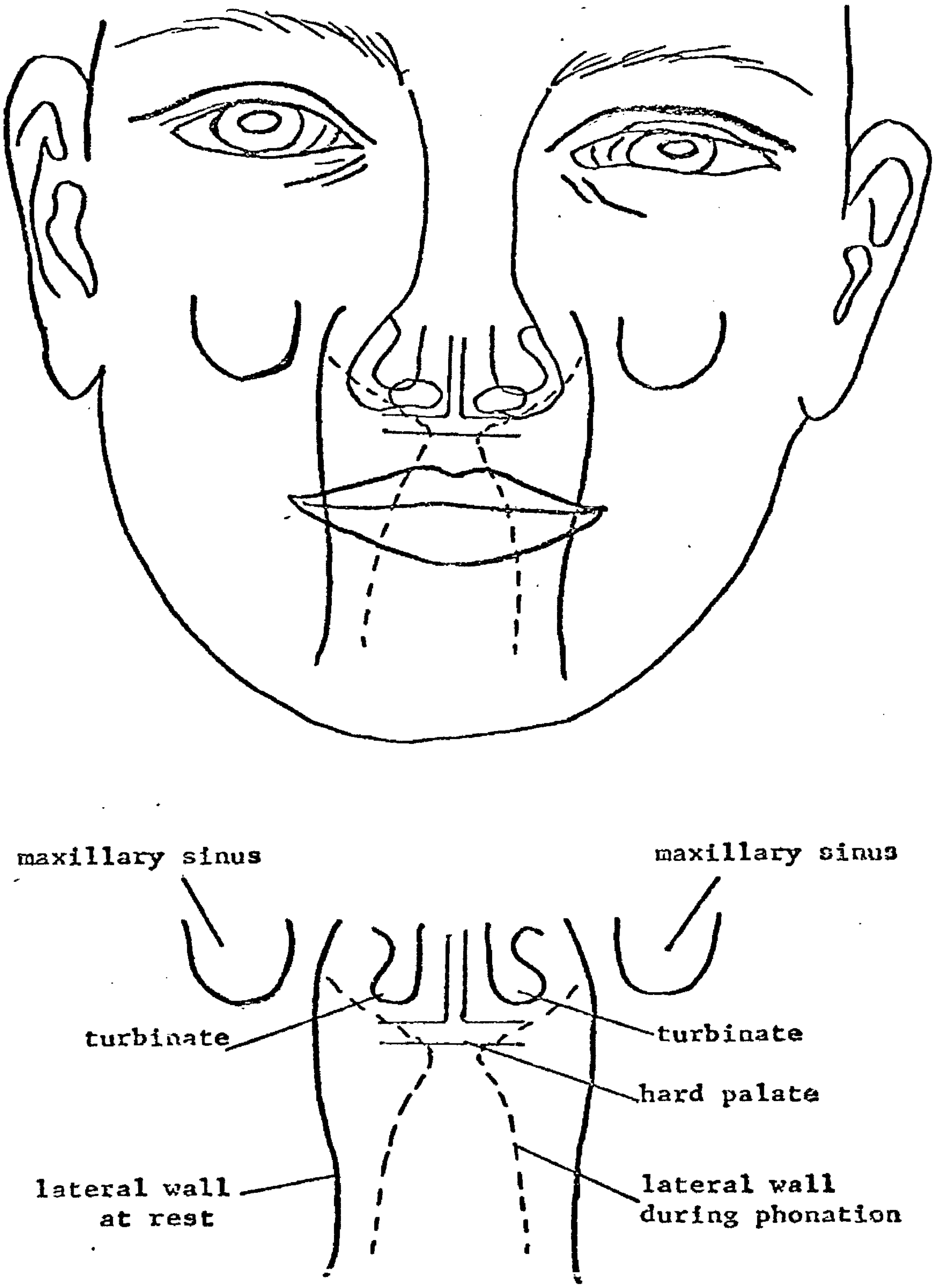


Fig. 2

TOWNE VIEW

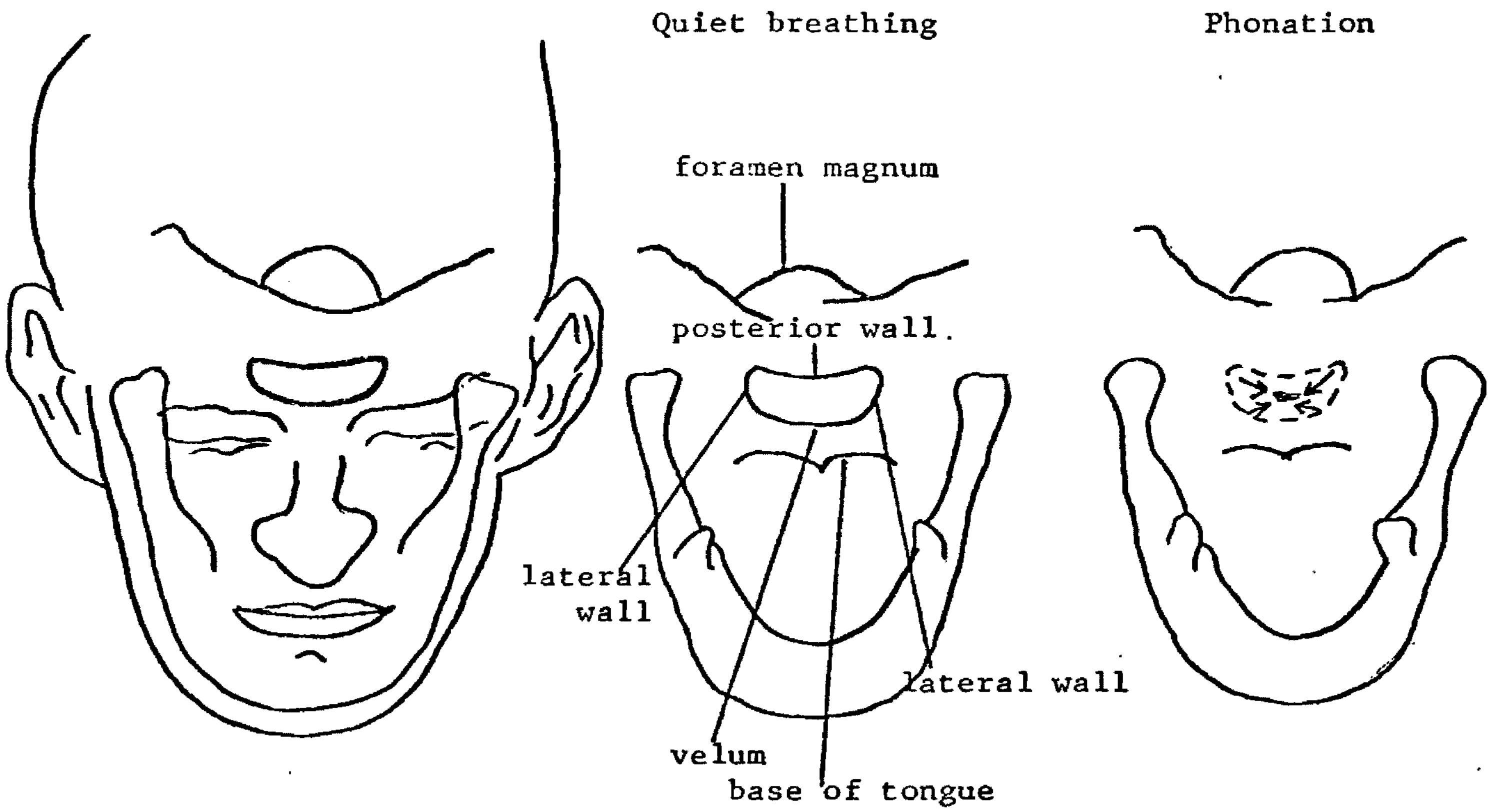
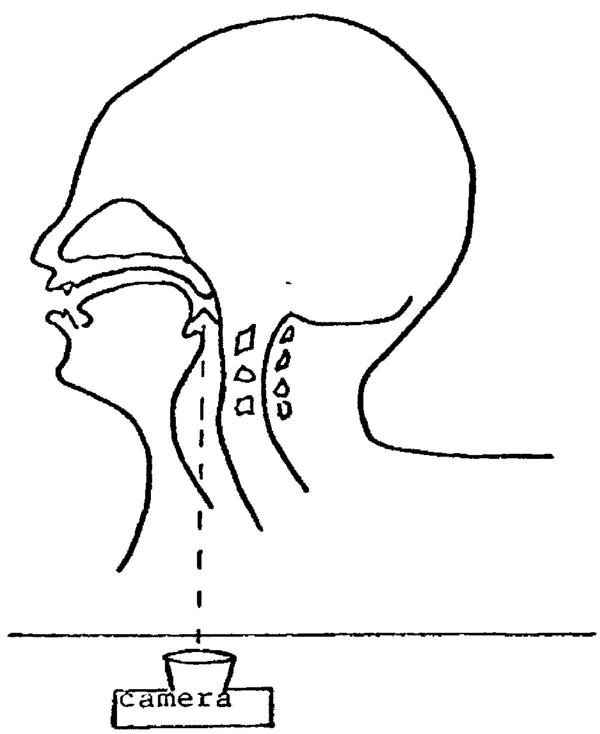
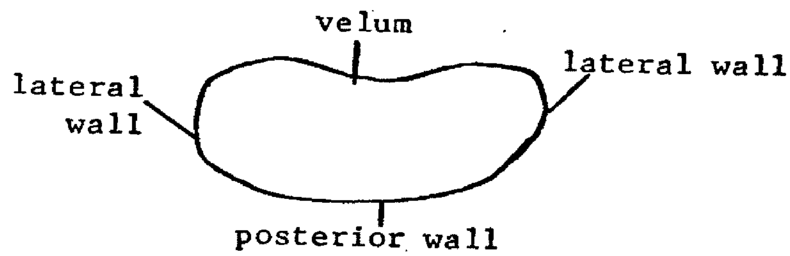


Fig. 3

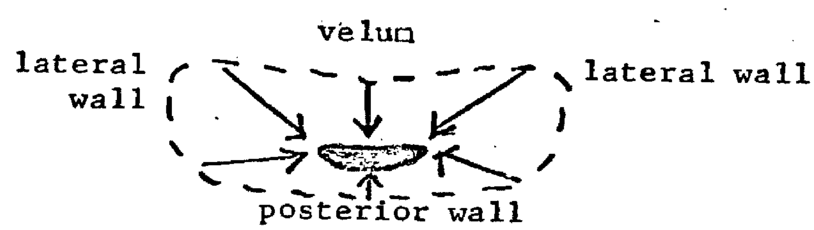
BASAL VIEW



Position cf patient



Quiet breathing



Phonation

Fig. 4

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APPENDIX A

Narrative and Instructions

Show title page.

Blank screen and read:

Videofluorography is a diagnostic procedure utilized in assessing competence of the velo-pharyngeal mechanism. This procedure, with its multiple views, permits evaluation of the functional integrity of the structures involved in VP closure. In videofluorography, the X-ray apparatus is attached to a video recorder and monitor so that actual movement of the structures can be seen as they occur. With simultaneous sound recording, the structural movements can be correlated to specific speech productions. Four different views, the lateral, frontal, basal and Towne views, provide sufficient information for assessing velo-pharyngeal competence. Drawings depicting structural landmarks and the mechanics of closure accompany the first series of multiple-view videofluorographic demonstrations. (pause) The following samples demonstrate the various videofluorographic techniques and the useful information they yield. Such information is critical to the speech pathologist in making recommendations for therapeutic or surgical intervention. Videofluorography can also aid the surgeon in selecting the appropriate surgical procedure for remediation of velopharyngeal insufficiency. (pause) The first case is a 7-year-old female who had a repaired bilateral cleft lip and palate and had undergone a pharyngeal flap surgery 2 years prior to this evaluation.

Show figure 1 (lateral view) and read the following as it is shown:

This drawing illustrates the structures seen in the lateral view. Note the superiorly-based flap. Now look at the videofluorography taken of the lateral view.

Show #44-53; female says: "You have to talk loud, Michelle."

Blank screen and read:

Now that you are oriented to the structures viewed in the lateral view, look again at the same film and observe the excellent velar movement.

Show #44-53; female says: "You have to talk loud, Michelle."

Blank screen and read:

Next, the Towne view demonstrates this patient's competent velopharyngeal sphinteric action. The following drawing shows orientation of the VP sphincter to surrounding anatomy.

Show Figure 2 (Towne view) and read as it is shown:

The figure at the left demonstrates the patient's head position. The Towne projection is performed with the patient supine on the fluoroscopic table with the chin tucked into the chest. The center figure shows the base of the tongue, the velum, lateral pharyngeal walls, posterior wall, and with this patient, a view of the pharyngeal flap. The figure at the right shows the sphincteric action of the VP mechanism with the flap. In the following footage, you will see that this child's VP portal at rest is shaped slightly asymmetrical.

Show #55-66; male says: "There's her sphincter, right there."

Blank screen and read:

The same Town view will be shown again and this time note the degree of lateral wall movement in the sphincter action. You will also see that this patient's closure pattern appears circular.

Show #55-66; male says: "There's her sphincter, right there."

Blank screen and read:

Next, the basal view confirms the previous Towne view by showing competent VP closure in speech activity. First the drawing shows the relationship of the structures seen in the basal view.

Show Figure 3 (basal view) and read as it is shown:

In the basal view of the VP portal, the plane of the portal is horizontal and therefore perpendicular to the X-ray beam. The patient is prone on the fluoroscopic table with the head and neck extended so that the invisible line running from the external auditory canal through the corner of the lips is horizontal. During quiet breathing, the portal is seen as a radiolucent oval fully marginated with barium. During phonation, the margins contract centrally. In the basal view, note that the velum now appears in the superior aspect of the portal with the posterior wall seen inferiorly. In the following view, observe the competent VP sphincter action.

Show #66-69; male says: "That's not so bad -- OK once more."

Blank screen and read:

Now, looking again at the same basal view film, note the contribution of the lateral pharyngeal walls.

Show #66-69; male says: "That's not so bad -- OK once more."

Blank screen and read:

Viewing this footage once more, you will note that this girl's closure is predominantly the result of AP function. That is, although contribution of lateral wall movement aids in closure, the closure mechanism is primarily the result of the flap and velar movement.

Show #66-69; male says: "That's not so bad -- OK once more."

Blank screen and read:

The next patient is a 16-year-old male who had a cleft palate repair surgery at age 18 months. Another repair was attempted when he was 10 years old. This young man presented with hypernasality and nasal emissions in connected and isolated speech productions. A fistula in the soft palate was visible in the oral peripheral examination. In the first exposure to the lateral view, look for the shortened velum.

Show #197-201; male says: "You can see where he's got a gap. Say it again."

Blank screen and read:

Now, looking at the same sequence, note some posterior pharyngeal wall movement as if in a compensatory attempt to obtain VP contact.

Show #197-201; male says: "You can see where he's got a gap. Say it again."

Blank screen and read:

This time, observe the gap present between the posterior wall and the velum.

Show #197-201; male says: "You can see where he's got a gap. Say it again."

Blank screen and read:

The basal view of this patient's VP portal demonstrates some medial movement of the lateral walls with minimal velar contribution. Diagnostically, the presence of lateral wall movement is important to the surgeon in deciding if a pharyngeal flap procedure is indicated. In the first presentation of the basal view, note the incomplete sphincter action of the patient's VP mechanism.

Show #213-228; male says: "There, now swallow. Let's straighten out his head."

Blank screen and read:

Look at the same sequence and observe the slight movement of the posterior wall and velum.

Show #213-228; male says: "There, now swallow. Let's straighten out his head."

Blank screen and read:

In the following Towne view of the VP portal, reasonable good lateral wall movement can be seen. Also, you will not that there is some velar movement, but because the velum is short, VP closure remains inadequate for speech purposes.

Show #168-192; male says: "Now say, I like cheesecake and coca-cola."

different male says: "I like cheesecake and coca-cola."

Blank screen and read:

The resulting recommendations for this patient were to perform a superiorly-based pharyngeal flap procedure and close the fistula. Following recovery from surgery, intensive speech therapy to train correct usage of the structures was recommended. (pause) The next patient is a 17-year-old male born with an incomplete cleft palate. At ages 2 and 4 he underwent palatoplasty surgeries. At age 15, a push-back procedure in conjunction with a superiorly-based flap surgery was performed. Throughout school, he has received speech therapy for reduction of hypernasality and nasal emission. Videofluorography revealed an incompetent VP mechanism as well as maladaptive tongue carriage interfering with articulation. In the lateral view, observe the inadequate VP contact in spite of a previous flap surgery. Look for the bubble in the barium coating indicating escapage of air throughout speech production.

Show #104-121; male says: "Say, I like cheesecake and coca-cola."

different male repeats.

Blank screen and read:

This time, in the same footage, observe the high-riding posterior tongue carriage in speech activity. Such posturing interfered noticeably with correct articulation of the tongue-tip sounds.

Show #104-121; male says: "Say, I like cheesecake and coca-cola."

different male repeats.

Blank screen and read:

In the following Towne view, look for the 2 portals lateral to the flap.

Show #122-137; male says: "Say, we 3 geese."

different male repeats.

Blank screen and read:

Looking again at this sequence of the Towne view, note the insufficient movement of the lateral walls in closing off these portals during speech production.

Show #122-137; male says: "Say, we 3 geese."

Blank screen and read:

Videofluorography clearly revealed an incompetent VP mechanism for this patient. Recommendations for further surgery to construct a mechanism physiologically capable of closure were mixed owing to failure of past surgeries and the patient's reluctance to undergo additional surgery. The speech pathologist did recommend, however, articulation therapy for training more appropriate tongue carriage so that intelligibility of tongue-tip sounds could be improved. (pause) The next example demonstrates the importance of having a simultaneous sound recording of the speech activity. The presence of a bubble in the barium indicates air leakage. Had this been viewed without sound, you would begin to suspect VP insufficiency. But because the bubble occurred as the patient uttered the word "and," escapage of air on the "n" is to be expected. The following lateral view shows the bubble. You will also notice how the velum contacts the posterior wall. A superior-based flap is not readily visible because of the collection of barium at the site.

Show #265-288; male says: "There's the soft palate, there is the posterior border, or posterior wall of the nasopharynx . . ."

Blank screen and read:

With videofluorography, the frontal view provides information about the degree of lateral wall movement and the point at which their maximum medial excursion occurs. Such information is important to the surgeon planning a flap surgery because the flap should be attached to the level on the vertical plane where maximum movement occurs.

Show Figure 4 (frontal view) and read it as shown:

Figure 4 represents the frontal view of the facial features and the relationship to the underlying lateral wall structures. For landmark purposes, the maxillary sinuses and turbinates are shown. For position of the lateral walls at rest is depicted with a solid line. The result of their medial movement during phonation is shown with a dotted line. The following videofluorographic frontal view demonstrates appropriate positioning of the flap on the vertical plane. Note that the lateral walls' point of maximum medial excursion occurs at the level of hard palate. Therefore, this maximal excursion point occurs behind the velum and so it is obscured. Had the flap been incorrectly positioned, either above or below this level, then the maximal excursion point would be seen. This short sequence will be shown twice. Look for the hard palate and its relationship to lateral wall movement.

Show #315-320; male says: "OK, say, we 3 geese."

different male repeats.

Show exact same footage again with slight pause in between.

Blank screen and read:

The following sequence shows the lateral wall movement of a normal subject. Again the actual point where maximum medial movement exists is obscured behind the velum because it occurs at the level of the hard palate. This subject's right lateral wall is easier to see because it was well-coated with barium. His left lateral wall did not retain much of the barium. Barium often does not adhere well to the lateral walls because of the mucous covering them. In the first sequence, look for excellent movement of the right lateral wall, seen on the left side of the screen.

Show #329-338; male says: "Say, I like cheesecake and coca-cola."

different male repeats.

Blank screen and read:

The next frontal view, taken after more barium was sniffed, shows good movement of the subject's left lateral wall as well, even though it doesn't appear as clearly as the right wall.

Show #348-353; male says: "I like cheesecake and coca-cola."

different male repeats.

Blank screen and read:

Look at this same sequence again and this time note the vertical extent of lateral wall approximation during swallowing activity.

Show #348-353; male says: "I like cheesecake and coca-cola."

different male repeats it.

Blank screen and read:

The next patient, a 6-year-old female, had normal speech until her tonsils and adenoids were removed. Afterwards, her speech was hypernasal and had nasal emissions. Videofluorography at the initial evaluation revealed minimal lateral wall movement and AP contact. A flap procedure was subsequently performed. The following videofluorography was obtained 4 months following the flap surgery. Again, the flap is obscured in the lateral view because of the barium. Some bubbling is also evident which appears to be related to a closure latency factor.

Show #230-242; male says: "OK, Wendy, say I like cheesecake and coca-cola."

Blank screen and read:

The same sequence will be shown again. This time, note that when the patient says "do" slowly, onset of voicing precedes velar elevation and the bubble is seen as the air escapes. This type of timing error is often seen in recently flapped patients who have not yet learned correct usage of a competent VP mechanism, so intensive therapy is indicated in this case.

Show #230-242; male says: "OK, Wendy, say I like cheesecake and coca-cola."

Blank screen and read:

In the following Towne view, the lateral portals can be seen. Note that this patient's closure pattern is that of a narrow slit.

Show #243-254; male says: "Lateral wall there, lateral wall there . . ."

Blank screen and read:

Looking at the film again, look for medial movement of the lateral walls. Note that it appears somewhat asymmetrical.

Show #243-254; male says: "Lateral wall there, lateral wall there. . ."

Blank screen and read:

In the following basal view, asymmetry of lateral wall movement is more readily seen. The left lateral pharyngeal wall appears to have greater excursion toward the mid-line in speech activity. Again, note the portals on either side of the flap. This sequence will be shown twice.

Show #255-263; male says: "Lateral wall here and here, wait, back there. . ."

Show exact same footage again with slight pause in between.

Blank screen and read:

In this case, videofluorography revealed competent VP sphincter action regardless of the asymmetrical lateral wall movement. Speech therapy to remediate the closure latency problem was recommended. (pause) The preceding videofluorographic studies have demonstrated the importance of obtaining objective data for assessment of VP competence and its bearing on providing appropriate and accurage recommendations. Each view offers diagnostic information in and of itself, but the maximum benefit of videofluorography comes with the pooling of information from the multiple-view procedures.